THE DIFFERENTIAL APTITUDE TEST: BACKGROUND, THEORY AND PROPOSED NINTH GRADE NORMS FOR KANSAS

by

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INTRODUCTION

Since the 1920's there has been an increasing recognition of the need for measurement of different aspects of human ability. The works of Thurstone, Spearman, Kelly, Cronbach, and others have made us aware of the limitations of the single score IQ test. The theories and research concerning the composition of these abilities have made us increasingly aware that intelligence is not a single trait but a collection or series of traits, of which a person may possess in different amounts. Many of the present tests measure IQ in terms of these abilities or aptitudes and then obscure the resultant information in a single score.

Testing, since this time, has progressed from the idea of a single measure of this type to a series of IQ tests measuring the same type of thing a number of times to obtain average IQ over a period of time. This process still hides the results in a single score.

The school counselor today is still faced with the same problems that faced counselors in the past--the problem of selecting the appropriate tests to measure the abilities of the student. The single-score "IQ test", so popular in the past, is being replaced by the aptitude test. These aptitude tests, many of which are no better than the tests that they replace, presume to measure specific abilities such as music, typewriting or assembly of small parts. Often these tests fail to predict the aptitude under consideration and though often labeled as aptitude or "prognostic" are essentially good intelligence tests.

Aptitude tests first appeared in a hit-or-miss fashion as a psychologist interested in a particular performance developed a device which he hoped would fit his needs.

Recent studies are beginning to provide a more systematic method of studying aptitudes. Instead of cataloging all the specific tests that have been written, it seems that it would be profitable to consider the major independent abilities in broader groupings.

Statement of Problem

An individual approaching the testing situation may become confused by the variety of tests available and the sometimes contradictory evidence available concerning these tests. Many aptitude tests and batteries of tests are on the market and the claims that the test publishers make for these tests are often confusing. Each would have the reader believe that his test is the best available and the only one to use. This report concerns itself with a review of some of the current tests, particularly the Differential Aptitude Test, proposed ninth grade norms for the Differential Aptitude Test, and a comparison of these norms with national norms supplied by the Psychological Corporation (Bennett, et al p. 1).

Procedure

The Differential Aptitude Test is not in general use in Kansas. A study (Table 1) by the Registrar of Kansas State

College in May, 1956 shows that only one out of 14 cities of the first class reported having used the DAT in their testing program and that only four out of 49 second class cities reported using this test. Those schools using the tests were asked for raw scores that were available. A few of the schools were using the DAT in grades other than the ninth grade but not enough to justify writing norms for grades other than the ninth. Slightly over 580 scores on each of the eight tests were available for both boys and girls in the ninth grade.

Table 1. Kansas schools using DAT during school year 1955-1956.

Schools	1st Cl. 14 of 18	2nd Cl. 49 of 66	Co. Com. 24 of 31	Rural & CSD 303 of 479	Total
Number of schools	1	4	2	10	17

Need for this Type of Information

Test scores are important only as they compare an individual with those with whom he will be competing either in the educational or vocational setting. National norms are important for comparison of the individual student when he will be competing against students on a national basis but are of little use when the pupil is competing against pupils only in his general region or state. In an educational situation a student usually will be competing against pupils only in his general area. The state is a convenient unit upon which to base norms for the use of the counselor.

Several recent events have emphasized the need for information of this type. These events are:

1. The setting of standards in Kansas for counseling and the qualifications for the counselor.[1]
2. The appointment of a committee to study statewide testing.
3. The general trend and recent emphasis on science and mathematics in our educational systems occasioned by the satellite programs.

These events in addition to the general trend toward educational and vocational guidance in the schools bring to a focus the problems heretofore mentioned facing the counselors in the Kansas educational system. This report is designed to provide a little more information to the school counselors in Kansas.

EARLY DEVELOPMENTS

Theory of Factor Analysis

Factor analysis is the mathematical tool used to sort out the abilities of man. It helps separate special aptitudes from the general intelligence and permits grouping of tests which overlap. Conclusions about what a test measures are drawn from its correlations with other tests. A table of intercorrelations permits us to study the relationships among a set of tests. Any correlation indicates that tests have a common element. That common element which causes tests to be correlated is a factor (Cronbach, 3, p. 192-212).

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[1] Kansas Certification Requirements, 1955.

Factor analysis has clarified theoretical and practical problems. It helps to reduce duplication in testing programs where tests with different names actually measure the same trait. It reduces a conglomerate of psychological tests to ordered families.

Intercorrelations permit one to identify three types of elements in tests: general factor, group factors and unique factors. A general factor is a factor present in all the tests in a given set. A group factor is a factor present in several but not all, of the tests under consideration. A unique factor is a characteristic which influences a score on only one of the tests. In recent studies of the organization of abilities, the central problem has been to identify the general, group, and unique factors in ability tests.

The actual mathematical processes involved are beyond the scope of this paper but a general rule is that when the correlations are high the possibility is that the tests are related. When the intercorrelations are low the possibility is that the tests are not related. When correlation is high the tests under consideration may be measuring the same trait or factor or related traits and factors.

Early Applications

Thurstone (Cronbach, 3) p. 204-205, was one of the pioneers in the use of factor analysis in this country. He found seven factors that recurred, leading him to believe that there were seven major types of ability. These factors were Spatial (S), Perceptual (P), Number (N), Verbal (V), Word Fluency (W), Memory (M), and Reasoning (R).

Thurstone followed his preliminary investigations with attempts to construct tests which would measure the separate primary mentsl abilities. Several batteries for different age levels have been produced in which each test was saturated with only one of the major factors. These tests yield a diagnosis or breakdown of mental development usually into six scores. More recently, brief editions claiming to measure factors in only five minutes each have been placed on the market. No acceptable evidence of reliability is available and some of the tests are probably undependable.

The American Counsel on Education Psychological Examination published by the Educational Testing Service (3) p. 185, another example of an early test, yields two scores: Linguistic ability (L), and Quantitative ability (Q). Linguistic ability includes vocabulary knowledge and ability to reason with words and quantitative ability includes skill and speed in arithmetic problems, numerical reasoning, and non-verbal reasoning.

Commins in Burros (2) p. 185, suggests the invalidity of separating these two scores, rating the test as a good intelligence test. The test publishers suggest going through each subtest in the series, giving careful attention to the type of questions missed inferring the use of this test to measure differential aptitudes. The test has, in the past, been quite popular and undoubtedly will retain its popularity. Many authors have issued individual tests of specialized aptitudes. These tests, however, make no pretense of factorial purity and retain many of the characteristics of the miniature situation type of test.

CURRENT TESTS - BASED ON FACTOR ANALYSIS

Criteria for Evaluation

Super (18) in his series of articles presented criteria governing the construction of a test battery. He stated that a multi-factored test used in counseling should describe a person as he is at the time of testing, should predict what he will be like at some future time, and what he will be able to do at some future date. The tests should be as timeless and should be as multi-potential as the persons they describe.

Tests should describe. A test used in counseling should be of immediate value to the counselor, describing the counselee just as he is at the time of the testing. The scores obtainable should give the counselee an accurate picture of how he compares with others in each criterion measured by the test. The tests should tell the counselee what scholastic and occupational groups he resembles and how well he resembles them. They should describe his strenghs and weaknesses in relation to one another.

Tests should predict. Tests should give the counselor a general idea of what the counselee will develop into in the future. They should predict in both educational and vocational fields so that the counselee will not spend a great deal of time training for an occupation which he did not want or had little aptitude.

Tests should be multi-potential. Just as people are made up of many different abilities and aptitudes in varying degrees of strength so should the tests be made of measures of many abilities. The measure they obtain should vary as the abilities vary.

Tests should be timeless. The tests should be valid as long as the population which is tested does not undergo a substantial change and the occupation in question has not changed. This characteristic makes it possible to make longitudinal studies of the test.

Current Tests

The General Aptitude Test Battery (11). The GATB was published in 1947 by the U. S. Employment Service. This battery is useful for counseling new entrants into the labor market or counseling those who are about to make some sort of occupational change. The test consists of twelve sub-tests combined in several ways to yield nine aptitude scores. The aptitude scores are in these fields: (G) Intelligence, (V) Verbal Aptitude, (N) Numerical Aptitude, (S) Spatial Aptitude, (P) Form Perception, (Q) Clerical Perception, (k) Motor Coordination, (F) Finger Dexterity, and (M) Manual Dexterity.

The GATB requires about two and one-fourth hours to administer. Raw scores are converted to standard scores for each test. The norms are in the form of a cutting score. These aptitude scores are standard scores where 100 represents the average of the general working population.

Super (17) evaluated the test as potentially very useful and one which does fairly in differentiation. He said that the test is useful for vocational guidance and is ready for use but is not valid for Educational Guidance. He stated that if the test authors carry out their plans for further studies that the test would be more useful.

The Guilford-Zimmerman Aptitude Survey (14). The GZAS measures aptitude or primary mental abilities in seven general areas. These areas are Verbal Comprehension, General Reasoning, Numerical Operations, Perceptual Speed, Spatial Orientation, Spatial Visualization, and Mechanical Knowledge. The authors stated that this test is applicable to senior high school students, college students, and adults who have had similiar levels of education. The validity seems to be more of the armchair type of validity not really backed up by extensive experimentation. Much of the material is an outgrowth of extensive Air Force test data.

Super (17) stated that the GZAS is a promising battery which may prove to be useful to counselors eventually if further data is collected and validated. He stated that the test is ready for research use only.

The Holzinger-Crowder Uni-Factor Tests (10). This test yields scores on (V) Verbal Ability, (S) Spatial Ability, (N) Numerical Ability, and (R) Reasoning Ability. These scores are obtained from a series of nine tests. The test although based on extensive factor analysis is frankly intended as an intelligence test.

Super (17) stated that this test is a good beginning but needs extensive study. His conclusion that it may prove less useful for non-academic prediction than some other batteries and is now ready for research use only.

The Factored Aptitude Series (15). The FAS, published in 1947, is a series of fourteen tests designed for use with adults in business and industry. The fourteen tests yield measure in eight areas or intelligence factors. The areas are Comprehension, Reasoning, Systems, Perception, Fluency, Memory, Space Relations, and Coordination.

Super (17) comments that this is a package deal promoted to business and industry designed to impress them but, that it fails to impress one who is familiar with tests. Insufficient data has been published to justify the sweeping claims of the authors. He concluded that the tests were not suitable for use.

The Multiple Aptitude Tests (16). The MAT consists of nine tests designed to yield measures of aptitude in four areas. The areas are Verbal Comprehension, Perceptual Speed, Numerical Reasoning, and Spatial Visualization. The authors stated that the tests are designed to provide data for use in the educational and vocational guidance of students in the secondary school. The authors also stated that the test may have considerable validity for placement and promotion in industry.

Super (17) stated that the test is a possible rival of the DAT and that it resembles it in many ways. The test is yet new and at present should be used for research studies only.

The Flanagan Aptitude Classification Tests (12). The FACT battery is an outgrowth of the authors' work in Air Force classification work during the war. The series consists of twenty-one tests or facts. Sixteen of these tests are paper and pencil tests while the other five are performance tests of some sort. The twenty-one tests are labeled as FACT 1, FACT 2, etc. Single or short word descriptions of these facts are: Coding, Inspection, Memory, Precision, Assembly, Scales, Coordination, Judgment and Comprehension, Arithmetic, Patterns, Components, Tables, Mechanics, Expression, Vocabulary, Reasoning, Planning, Ingenuity, Alertness, Tapping, and Carving. The tests of this series require seven hours and fifteen minutes of working time to complete. These tests actually would take much longer because of time for preparation, handing out test booklets, etc. Flanagan has announced an ambitious program of validation for these tests.

Super (17) commented that this series of tests deserves further investigation and consideration. He states that this series is ready for use in research and limited vocational counseling.

The Tests of Primary Mental Abilities (19). The PMA yields measures of the Primary Mental Abilities identified as: Verbal Comprehension (V), Word Fluency (W), Memory Factor (M), Space Factor (S), Inductive (I) and Deductive (D), Reasoning (R), and Perceptual Speed (P).

Super (17) comments concerning the Primary Mental Abilities were that they no longer are suitable for use, with the added observation that the person who blazes the trail and builds the first log cabin does not necessarily build a good house for the city which later develops.

THE DIFFERENTIAL APTITUDE TEST

The needs for an aptitude test or a series of aptitude tests have been discussed earlier in this report. The need has been for an integrated battery of tests standardized on a single population in which the relationship of each test to others in the series is known and each set of norms can be interpreted in the same way.

Criteria (1) have been set up by the publishers of this test. These criteria are:

1. Each test should be an independent test.
2. Each test should be adequately reliable
3. The tests should measure power.
4. The test battery should yield a profile.
5. The norms should be adequate.
6. The test materials should be practical.
7. The tests should be easy to administer.
8. Time units should be convenient.
9. Alternate forms should be available.

Comparison of these criteria with Super's (18) criteria reveals that the former deal more with the mechanical aspect of test construction while Super's criteria deal with evaluation of a comparative nature of the test with another series of tests.

The eight sub-tests of the DAT are discussed below.

Verbal Reasoning (V) is intended to measure a student's ability to understand concepts framed in words. Ability to abstract or generalize and to think constructively is important rather than simple fluency or vocabulary recognition. This test is expected to succeed in fields where complex verbal relationships and concepts are important.

Numerical Ability (N) is arranged to test skill in solving arithmetic problems rather than arithmetic reasoning. This was prompted by the desire to avoid the language elements of the usual arithmetic reasoning problem.

Abstract Reasoning (A) is intended as a non-verbal measure of the student's reasoning ability and ability to deal with abstractions.

Space Relation (S) is a measure of ability to deal with concrete materials through visualization and to manipulate things mentally.

Mechanical Reasoning (R) is essentially a new form of the series of Mechanical Comprehension Tests. This test is a tried and proven test measuring ability to learn the principles of operation and repair of complex devices. The score is effected by the experience of the student.

Clerical Speed and Accuracy (CSA) is intended as a measure of response in a simple perceptual task. This is a test of speed rather than a test of power. The test scores are related to success in clerical work.

Language Usage (LU) is divided into two parts: Spelling and Sentences. The spelling list in this test was compiled from Gate's Spelling Difficulties in 3476 Words. The sentences section is intended to measure the student's ability to distinguish between good and bad grammar, punctuation, and word usage.

Norms, Population and Structure

The norms for the Differential Aptitude Test represent scores from at least 100 communities in 26 states using a total of over 47 thousand students. The norms are in the form of percentile tables for boys and girls for Forms A and B of test. This represents 32 tables for each of the five grades eight through twelve. It is possible for a student to have a negative score on the test because of the scoring formula. In all cases this negative score is regarded as zero.

The authors have started a longitudinal study (23) of the students now included in the normative study. This should add some validity to the test for its use as a vocational test.

Super (17) rates the DAT as the best test available at the present time for use in educational counseling.

Studies of Validity

The validity studies (1) (8) (23) (24) reported by the publishers relate to the validity of the test in respect to success in different subject matter areas. Almost four thousand validity coefficients reported in the manual are somewhat overwhelming to the average counselor although a study of these data revealed, according to Super (17), that the tests are predictive, but not differentially predictive. The publishers stated that evidence is strong that the DAT is useful as a predictor of grades in courses taken a considerable time after the administration of the test. Close agreement with course grades is high as could be expected considering the different factors taken into consideration in this grading.

The Seven Year Follow Up (23) p. 1, reported by the publishers concluded that

> The Differential Aptitude Tests reveal important profile differences among high school students who enter diverse occupational and educational careers. Further, those abilities which counselors would expect to be distinctive in particular groups are actually found to be outstanding.

The diverse validity data reported is related to its validity in specific cases. An over all validity coefficient or statement is out of place (1).

> The large amount of data presented in this manual may be confusing to test users who are accustomed to seeing a single validity coefficient for a test and accepting it as applicable to all situations. The more sophisticated test user, who understands that validity must differ as the course and the pupils differ, will recognize that data at least as plentiful as these are necessary for full understanding of the tests.

Comparison with Validity Data for Other Tests in This Field

Study of published material concerning the GATB (11) p. 150, as reported in the Personnel and Guidance Journal revealed that little data has been published by the United States Employment Service concerning validity. The data published has the characteristics of the function of the test. Most of the validity data collected for this test is in terms of success and satisfaction on the job.

Validity reported on the FACT (12) p. 503, was much the same type of data although these data compared the students, who took the test, with their success in later high school and college. Flannagan announced his intentions of extensive validity and follow-up studies following test publication.

Several other tests, reported by Super (17) p. 19, that looked promising have little or no validity data published. His comment on each is that the tests are ready for research use but not for counseling.

PROPOSED NORMS FOR KANSAS

The question of whether national norms for the DAT are suitable for comparisons within the Kansas population has not yet been answered. Consequently, it was considered desirable to develop Kansas norms to the extent that data were available and to compare these with the national norms.

Schools and Population

Norms have been compiled from scores obtained from high schools in Kansas which were able to provide data for this purpose. The cooperating schools were Junction City, Abilene, and Highland Park in Topeka. The scores were all taken from the school years 1956-57 or 1957-58, and in most cases were from the school year 1957-58.

The norms were arranged in the same form that the national norms were arranged. The actual distribution is shown in the Appendix of this report. Raw scores are presented in this way so any counselor who wishes to do further research into this subject will have this author's data in a form usable to him. Proposed Kansas norms for ninth grade pupils are shown on the following pages in Tables 2 and 3.

Table 2. Proposed Kansas norms for ninth grade boys on the DAT.

	Raw Scores							N=600+
Pe.	Verb. Reas.	Num. Abil.	Abs. Reas.	Space Rela.	Mech. Reas.	Cler. S & A	Lu-1 Spell.	Lu-11 Sent.
99	40+	31+	44+	87+	65+	73+	83+	59+
97	38-39	29-30	42-43	85-87	60-64	67-73	77-82	53-58
95	35-37	26-28	39-41	83-84	57-59	62-66	73-76	48-52
90	32-34	24-25	37-38	76-82	53-56	60-61	65-72	43-47
85	28-32	23	36	74-75	51-52	57-59	57-64	37-42
80	26-27	22	35	70-73	50	55-56	52-56	33-36
75	25	21	34	65-69	47-49	54	47-51	31-32
70	23-24	19-20	32-33	61-65	45-46	52-53	42-46	28-30
65	22	18	31	57-60	44	51	36-41	26-27
60	21	16-17	30	53-56	43	49-50	32-35	23-25
55	19-20	15	29	49-52	42	48	28-31	21-22
50	18	14	28	44-48	40-41	47	24-27	19-20
45	17	13	26-27	41-43	39	45-46	20-23	16-18
40	16	12	25	36-40	36-38	44	16-19	15
35	15	10-11	23-24	31-35	35	43	12-15	13-14
30	13-14	9	21-22	27-30	33-34	41-42	9-11	11-12
25	11-12	8	19-20	24-26	30-32	40	6-8	8-10
20	10	6-7	15-18	20-24	27-29	38-39	0-5	4-7
15	8-9	5	10-14	16-19	23-26	36-37	0	0-3
10	7	2-4	2-9	12-15	19-22	32-35	0	-
5	5-6	1	1	7-11	13-18	27-31	0	-
3	2-4	0	0	4-6	10-12	14-26	0	-
1	0-1	0	0	0-3	0-9	0-13	0	-
Mean	17.7	16.2	27.0	43.8	37.1	55.3	28.1	21.8
S. D.	9.2	8.5	11.1	24.2	13.2	12.5	25.3	16.0

Table 3. Proposed Kansas norms for ninth grade girls on the DAT.

				Raw Scores				
Pc.	Verb. Reas.	Num. Abil.	Abs. Reas.	Space Rela.	Mech. Reas.	Cler. S & A	Lu-1 Spell.	Lu-2 Sent.
99	40+	36+	45+	93+	47+	92+	95+	63+
97	38-39	33-35	44	84-92	45-46	86-91	88-94	59-62
95	35-37	31-32	42-43	77-83	42-44	81-85	84-87	55-58
90	31-34	20-30	40-41	70-76	40-41	73-80	78-83	51-54
85	29-30	26-27	38-39	65-69	38-39	70-72	71-77	47-50
80	27-28	24-25	37	61-64	36-37	66-69	66-70	43-46
75	25-26	23	35-36	58-60	34-35	64-65	61-65	41-42
70	23-24	22	34	55-57	32-33	62-63	55-60	37-40
65	22	21	33	52-54	31	61	51-54	34-36
60	21	20	32	48-51	29-30	60	47-50	33
55	20	18-19	31	44-47	28	58-59	44-46	30-32
50	19	17	29-30	41-43	27	57	43	28-29
45	17-18	16	27-28	38-40	25-26	56	40-42	26-27
40	16	15	26	34-37	24	55	36-39	24-25
35	15	14	25	31-32	23	53-54	31-35	22-23
30	14	12-13	23-24	28-30	21-22	51-52	27-30	20-21
25	13	11	21-22	24-27	19-20	50	22-26	16-19
20	12	10	18-20	21-23	17-18	48-49	17-21	14-15
15	11	9	16-17	18-20	15-16	46-47	11-16	9-13
10	9-10	7-8	12-15	12-17	11-14	45	3-10	5-8
5	7-8	4-6	7-10	7-11	7-10	40-44	0-3	3-4
3	6	2-3	2-6	5-6	4-6	35-39	-	0-2
1	0-5	0-1	0-1	0-4	0-3	0-34	-	-
Mean	18.4	16.7	26.7	39.3	25.3	55.3	40.5	27.9
S. D.	8.4	8.8	8.9	20.0	11.4	12.5	25.6	16.5

Table 4. Comparison of national and proposed Kansas ninth grade norms for boys on the DAT.

	Verb	Reas	Num	Abil	Abs	Reas	Space	Rela	Mech	Reas	Cler	S + A	Lu-1		Lu-2	
Pe	Natl	Ks	Natl	Ks	Natl	Ks	Natl	Ks	Natl	Ks	Natl	Ks	Natl	Ks	Natl	Ks
90	30-32	32-34	27-29	24-25	37-38	37-38	69-74	76-82	50-52	53-56	59-61	60-61	63-71	65-72	42-46	43-47
75	24	25	22	21	32-33	34	56-59	65-69	44-45	47-49	53-54	54	47-50	47-51	33-34	31-32
50	17	18	16	14	26	28	37-40	44-48	35-36	40-41	47	47	26-30	24-27	22-24	19-20
25	12	11-12	10	8	16-18	19-20	17-20	24-26	26-27	30-32	40-41	40	9-12	6-8	12-13	8-10
10	7-8	7	5-6	2-4	4-8	2-9	7-10	12-15	16-19	19-22	33-35	32-35	1	0	2-5	—
Mn	18.3	17.7	16.3	16.2	24.1	27.0	39.1	43.8	34.9	37.1	47.0	55.3	31.1	28.1	23.7	21.8
SD	8.7	9.2	8.2	8.5	11.3	11.1	23.4	24.2	12.6	13.2	10.5	12.5	24.1	7.9	14.6	16.0

Table 5. Comparison of national and proposed Kansas ninth grade norms for girls on the DAT.

	Verb	Reas	Num	Abil	Abs	Reas	Space	Rela	Mech	Reas	Cler	S + A	Lu-1		Lu-2	
Pe	Natl	Ks	Natl	Ks	Natl	Ks	Natl	Ks	Natl	Ks	Natl	Ks	Natl	Ks	Natl	Ks
90	30-32	31-34	26-28	29-30	37-38	40-41	60-65	70-76	35-37	40-41	67-70	73-80	75-80	78-83	50-53	51-54
75	24-25	25-26	21-22	23	32	35-36	47-50	58-60	29-30	34-35	61-62	64-65	62-65	61-65	41-43	41-42
50	17-18	19	16	17	25	29-30	30-33	41-43	21-22	27	54	57	43-46	43	31-32	28-29
25	12	13	10	11	14-16	21-22	16-18	24-27	14-15	19-20	47-49	50	23-26	22-26	20-22	16-19
10	8-9	9-10	5-6	7-8	3-6	12-15	7-9	12-17	7-9	11-14	40-42	45	6-12	3-10	10-13	5-8
Mn	18.7	18.4	16.1	16.7	23.1	26.7	33.8	39.3	21.9	25.3	54.4	55.3	44.0	40.5	31.6	27.9
SD	8.6	8.4	7.8	8.8	11.6	8.9	20.3	20.0	10.5	11.4	11.3	12.5	24.8	25.6	15.1	16.5

Table 6. Significance of differences of means between national and proposed Kansas norms for ninth grade boys on the DAT.

Name of Test	National		Kansas		Difference in Means	t.
	Mean	SD	Mean	SD		
Verbal Reas.	18.3	8.7	17.7	9.2	.6	.794
Numerical Abil.	16.3	8.2	16.2	8.5	.1	.1465
Abstract Reas.	24.1	11.3	27.0	11.1	2.9	2.53
Space Rela.	39.1	23.4	43.8	24.2	4.7	2.89 **
Mech. Reas.	34.9	12.6	37.1	13.2	2.2	1.136 *
Clerical S & A	47.0	10.5	55.3	12.5	8.3	3.57 **
Lu-1	31.1	24.1	28.1	25.3	3.0	2.48 *
Lu-2	23.7	14.6	21.8	16.0	1.9	2.03 **

Table 7. Significance of differences of means between national and proposed Kansas norms for ninth grade girls on the DAT.

Name of Test	National		Kansas		Difference in Means	t.
	Mean	SD	Mean	SD		
Verbal Reas.	18.7	8.6	18.4	8.4	.3	.372
Numerical Abil.	16.1	7.8	16.7	8.8	.6	.264
Abstract Reas.	23.1	11.6	26.7	8.9	3.6	3.278**
Space Rela.	33.8	20.3	39.3	20.0	5.5	3.276**
Mech. Reas.	21.9	10.5	25.3	11.4	3.4	3.158**
Clerical S & A	54.4	11.3	55.3	12.5	.9	.476
Lu-1	44.0	24.8	40.5	25.6	3.5	2.061**
Lu-2	31.6	15.1	27.9	16.5	3.7	2.866**

* Significant to the five per cent level of confidence.
** Significant to the one per cent level of confidence.

Comparison with National Norms

Inspection of Tables 6 and 7 shows that the Kansas means are higher than national means in Abstract Reasoning, Space Relations, Mechanical Reasoning, and Clerical Speed and Accuracy for both boys and girls. They are lower for both boys and girls in Language Usage: Spelling and Sentences, than national means.

Tables 5 and 6 show the significance of differences of means between national and proposed Kansas ninth grade norms. According to Table 5 differences significant to the five per cent level of confidence exist between means on the Abstract Reasoning, Mechanical Reasoning and Language 1 (Spelling) tests for boys. Differences in means significant to the one per cent level of confidence exist between Kansas and national means on the Space Relations, Clerical Speed and Accuracy, and Language 2 (Sentences) tests for boys. Significance to the one per cent level is to be found on the Abstract Reasoning, Space Relations, Mechanical Reasoning, and Language (Spelling and Sentences) tests for girls.

Although 10 of the differences are statistically significant at the one per cent level of confidence and one at the five per cent level, examination of Table 29 of the Manual for the DAT (1) reveals that the differences are of no practical significance except for the Clerical Speed and Accuracy test for boys. On this test the difference of means was larger than the standard error of measurement. The difference of means on this test was 8.3 while the standard error of measurement was 3.7. On all the other tests the standard error of measurement was larger than the difference of means. Therefore, the proposed Kansas norms do not appear to be more suitable for use in comparing Kansas pupils with Kansas pupils than are national norms.

CONCLUSIONS AND RECOMMENDATIONS

No significant differences of practical importance were found between national norms for the ninth grade and the proposed Kansas norms for the ninth grade. The number of students under consideration, was however, relatively small as compared with the national norms. Also, this study was restricted to several schools while the national norms covered over one hundred schools widely distributed throughout the United States.

It appears desirable that as soon as the DAT is used in a more representative sampling of Kansas high schools a similar study be made on a more representative population. Also, a particular high school using the DAT should build up local norms and make comparisons of these with the national norms to determine significant differences. Such differences should then be taken into account in making comparisons within the school.

Further, it is recommended that high school counselors, teachers, and principals make more extensive use of differential aptitude tests. In general, most high schools in Kansas are not yet making use of the most significant research and developments of the past ten to fifteen years in guidance testing.

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APPENDIX

Table 8. Distribution of raw scores for ninth grade Kansas boys on the verbal reasoning section of the DAT.

Raw Score	Number	Raw Score	Number	N=606
50	0	24	16	
49	0	23	21	
48	0	22	32	
47	0	21	19	
46	1	20	25	
45	1	19	21	
44	1	18	24	
43	0	17	26	
42	2	16	26	
41	1	15	31	
40	3	14	26	
39	2	13	22	
38	3	12	15	
37	6	11	27	
36	3	10	23	
35	4	9	21	
34	3	8	27	
33	5	7	21	
32	7	6	14	
31	5	5	7	
30	7	4	13	
29	9	3	12	
28	18	2	3	
27	15	1	1	
26	10	0	0	
25	27			

Table 9. Distribution of raw scores for ninth grade Kansas boys on the numerical ability section of the DAT.

Raw Score	Number	Raw Score	Number	N=602
40	0	19	23	
39	0	18	19	
38	0	17	19	
37	1	16	28	
36	1	15	21	
35	5	14	30	
34	4	13	21	
33	4	12	30	
32	4	11	18	
31	10	10	28	
30	12	9	25	
29	10	8	13	
28	6	7	16	
27	7	6	24	
26	20	5	18	
25	23	4	9	
24	20	3	7	
23	26	2	6	
22	26	1	11	
21	20	0	16	
20	21			

Table 10. Distribution of raw scores for ninth grade Kansas boys on the abstract reasoning section of the DAT.

Raw Score	Number	Raw Score	Number	N=571
50	0	24	16	
49	1	23	7	
48	1	22	20	
47	0	21	16	
46	1	20	14	
45	7	19	4	
44	9	18	10	
43	5	17	8	
42	10	16	10	
41	8	15	8	
40	11	14	7	
39	17	13	2	
38	14	12	4	
37	13	11	5	
36	23	10	5	
35	31	9	3	
34	26	8	2	
33	21	7	9	
32	29	6	2	
31	25	5	1	
30	29	4	3	
29	28	3	3	
28	13	22	4	
27	15	1	4	
26	24	0	24	
25	19			

Table 11. Distribution of raw scores for ninth grade Kansas boys on the space relations section of the DAT.

Raw Score	Number	Raw Score	Number	Raw Score	Number	N=617
100	0	66	4	32	8	
99	0	65	8	31	5	
98	1	64	4	30	6	
97	0	63	8	29	11	
96	0	62	7	28	6	
95	0	61	9	27	6	
94	0	60	11	26	10	
93	9	59	4	25	10	
92	2	58	5	24	8	
91	1	57	7	23	16	
90	1	56	14	22	4	
89	0	55	10	21	5	
88	1	54	9	20	8	
87	2	53	3	19	15	
86	1	52	9	18	6	
85	2	51	10	17	9	
84	6	50	12	16	5	
83	4	49	8	15	11	
82	10	48	11	14	10	
81	2	47	5	13	7	
80	4	46	7	12	5	
79	4	45	7	11	5	
78	2	44	4	10	8	
77	5	43	8	9	6	
76	8	42	6	8	3	
75	9	41	12	7	9	
74	2	40	8	6	4	
73	14	39	8	5	4	
72	10	38	9	4	4	
71	8	37	3	3	7	
70	19	36	5	2	3	
69	9	35	7	1	1	
68	2	34	5	0	7	
67	5	33	4			

Table 12. Distribution of raw scores for ninth grade Kansas boys on the mechanical reasoning section of the DAT.

Raw Score	Number	Raw Score	Number	N=590
68	0	33	11	
67	2	32	17	
66	0	31	4	
65	3	30	12	
64	3	29	13	
63	3	28	6	
62	3	27	6	
61	3	26	18	
60	1	25	5	
59	4	24	7	
58	4	23	12	
57	4	22	5	
56	8	21	10	
55	5	20	5	
54	2	19	9	
53	14	18	8	
52	12	17	5	
51	8	16	6	
50	23	15	4	
49	17	14	4	
48	10	13	2	
47	17	12	3	
46	13	11	5	
45	18	10	2	
44	30	9	7	
43	15	8	5	
42	17	7	3	
41	28	6	1	
40	11	5	1	
39	21	4	0	
38	32	3	0	
37	12	2	0	
36	9	1	2	
35	24	0	2	
34	14			

Table 13. Distribution of raw scores for ninth grade Kansas boys on the clerical - speed and accuracy section of the DAT.

Raw Score	Number	Raw Score	Number	Raw Score	Number	N=600
100	0	66	3	32	2	
99	0	65	8	31	2	
98	0	64	6	30	1	
97	0	63	9	29	4	
96	2	62	13	28	0	
95	0	61	9	27	4	
94	0	60	15	26	1	
93	0	59	5	25	2	
92	0	58	17	24	4	
91	0	57	14	23	1	
90	2	56	20	22	0	
89	0	55	15	21	1	
88	0	54	21	20	1	
87	1	53	16	19	0	
86	1	52	24	18	0	
85	1	51	18	17	1	
84	0	50	29	16	0	
83	0	49	27	15	0	
82	1	48	28	14	1	
81	1	47	12	13	1	
80	1	46	10	12	0	
79	0	45	24	11	0	
78	2	44	23	10	0	
77	0	43	27	9	0	
76	0	42	18	8	2	
75	3	41	19	7	0	
74	1	40	25	6	1	
73	0	39	15	5	0	
72	0	38	16	4	0	
71	2	37	18	3	0	
70	2	36	12	2	0	
69	3	35	6	1	0	
68	2	34	7	0	2	
67	4	33	11			

Table 14. Distribution of raw scores for ninth grade Kansas boys on the language usage - spelling section of the DAT.

Raw Score	Number	Raw Score	Number	Raw Score	Number	N=593
100	0	66	6	32	10	
99	0	65	0	31	5	
98	0	64	7	30	12	
97	0	63	0	29	4	
96	1	62	7	28	9	
95	0	61	2	27	6	
94	1	60	8	26	8	
93	0	59	0	25	8	
92	0	58	4	24	6	
91	0	57	2	23	6	
90	1	56	10	22	11	
89	0	55	2	21	7	
88	1	54	7	20	7	
87	1	53	5	19	8	
86	1	52	11	18	8	
85	0	51	4	17	5	
84	3	50	11	16	8	
83	0	49	4	15	7	
82	1	48	2	14	9	
81	0	47	6	13	5	
80	1	46	10	12	12	
79	1	45	3	11	6	
78	8	44	8	10	9	
77	0	43	4	9	7	
76	4	42	6	8	13	
75	1	41	3	7	10	
74	4	40	7	6	7	
73	1	39	5	5	7	
72	6	38	5	4	22	
71	1	37	0	3	7	
70	6	36	10	2	3	
69	0	35	4	1	9	
68	6	34	8	0	103	
67	3	33	7			

Table 15. Distribution of raw scores for ninth grade Kansas boys on the language usage - sentence section of the DAT.

Raw Score	Number	Raw Score	Number	Raw Score	Number	N=598
95	0	62	1	29	13	
94	0	61	1	28	10	
93	0	60	2	27	14	
92	0	59	4	26	15	
91	0	58	1	25	11	
90	0	57	2	24	7	
89	0	56	4	23	6	
88	0	55	3	22	23	
87	0	54	2	21	13	
86	0	53	1	20	12	
85	0	52	3	19	12	
84	0	51	1	18	16	
83	0	50	4	17	8	
82	0	49	2	16	16	
81	0	48	3	15	14	
80	0	47	3	14	17	
79	0	46	2	13	11	
78	0	45	7	12	20	
77	2	44	7	11	18	
76	0	43	4	10	16	
75	0	42	9	9	11	
74	0	41	10	8	9	
73	0	40	4	7	6	
72	0	39	1	6	6	
71	0	38	6	5	15	
70	0	37	5	4	7	
69	0	36	8	3	11	
68	0	35	10	2	12	
67	0	34	6	1	4	
66	0	33	6	0	93	
65	0	32	3			
64	0	31	16			
63	0	30	15			

Table 16. Distribution of raw scores for ninth grade Kansas girls on the verbal reasoning section of the DAT.

Raw Score	Number	Raw Score	Number	N=621
50	0	24	13	
49	0	23	20	
48	0	22	26	
47	0	21	32	
46	0	20	26	
45	0	19	19	
44	0	18	28	
43	0	17	27	
42	2	16	29	
41	0	15	33	
40	3	14	20	
39	4	13	31	
38	3	12	26	
37	2	11	23	
36	3	10	26	
35	6	9	17	
34	5	8	14	
33	6	7	14	
32	8	6	17	
31	10	5	15	
30	11	4	6	
29	8	3	5	
28	25	2	1	
27	25	1	2	
26	14	0	0	
25	16			

Table 17. Distribution of raw scores for ninth grade Kansas girls on the numerical ability section of the DAT.

Raw Score	Number	Raw Score	Number	N=625
40	1	19	32	
39	0	18	14	
38	2	17	33	
37	0	16	29	
36	3	15	21	
35	3	14	39	
34	6	13	20	
33	3	12	11	
32	4	11	35	
31	10	10	30	
30	12	9	19	
29	12	8	22	
28	13	7	9	
27	7	6	15	
26	12	5	13	
25	23	4	15	
24	16	3	7	
23	29	2	6	
22	25	1	4	
21	26	0	16	
20	28			

Table 18. Distribution of raw scores for ninth grade Kansas girls on the abstract reasoning section of the DAT.

Raw Score	Number	Raw Score	Number	N-614
50	1	24	19	
49	1	23	10	
48	1	22	18	
47	0	21	9	
46	0	20	13	
45	5	19	15	
44	10	18	2	
43	4	17	17	
42	9	16	13	
41	14	15	9	
40	18	14	17	
39	17	13	6	
38	10	12	6	
37	20	11	5	
36	21	10	6	
35	23	9	7	
34	34	8	6	
33	13	7	2	
32	22	6	8	
31	32	5	3	
30	28	4	3	
29	17	3	3	
28	20	2	0	
27	16	1	4	
26	20	0	15	
25	43			

Table 19. Distribution of raw scores for ninth grade Kansas girls on the space relations section of the DAT.

Raw Score	Number	Raw Score	Number	Raw Score	Number	N=613
100	0	66	7	32	8	
99	0	65	5	31	13	
98	0	64	7	30	9	
97	0	63	4	29	15	
96	0	62	10	28	9	
95	0	61	7	27	11	
94	1	60	9	26	10	
93	1	59	8	25	6	
92	0	58	12	24	6	
91	0	57	8	23	13	
90	2	56	11	22	9	
89	0	55	9	21	9	
88	1	54	14	20	14	
87	1	53	11	19	9	
86	0	52	10	18	8	
85	0	51	9	17	7	
84	2	50	6	16	4	
83	3	49	10	15	3	
82	4	48	12	14	9	
81	0	47	6	13	5	
80	2	46	3	12	4	
79	1	45	7	11	8	
78	1	44	11	10	4	
77	1	43	8	9	7	
76	2	42	4	8	5	
75	4	41	17	7	10	
74	2	40	8	6	7	
73	7	39	9	5	1	
72	6	38	8	4	3	
71	5	37	12	3	2	
70	6	36	6	2	1	
69	7	35	7	1	1	
68	6	34	6	0	12	
67	6	33	10			

Table 20. Distribution of raw scores for ninth grade Kansas girls on the mechanical reasoning section of the DAT.

Raw Score	Number	Raw Score	Number	N=622
68	0	33	15	
67	0	32	23	
66	0	31	19	
65	0	30	13	
64	0	29	23	
63	0	28	23	
62	0	27	21	
61	0	26	37	
60	1	25	14	
59	1	24	26	
58	0	23	24	
57	2	22	19	
56	0	21	15	
55	1	20	24	
54	0	19	12	
53	4	18	18	
52	1	17	15	
51	1	16	16	
50	2	15	9	
49	1	14	18	
48	0	13	4	
47	3	12	11	
46	1	11	9	
45	6	10	7	
44	7	9	11	
43	4	8	9	
42	5	7	5	
41	15	6	7	
40	10	5	5	
39	6	4	2	
38	20	3	3	
37	15	2	3	
36	15	1	2	
35	20	0	11	
34	18			

Table 21. Distribution of raw scores for ninth grade Kansas girls on the clerical-speed and accuracy section of the DAT.

Raw Score	Number	Raw Score	Number	Raw Score	Number	N=646
100	2	66	12	32	1	
99	1	65	12	31	0	
98	0	64	15	30	2	
97	0	63	23	29	2	
96	1	62	19	28	0	
95	2	61	21	27	0	
94	0	60	24	26	1	
93	1	59	21	25	1	
92	1	58	25	24	0	
91	2	57	24	23	0	
90	1	56	24	22	0	
89	2	55	27	21	1	
88	3	54	18	20	0	
87	0	53	28	19	0	
86	3	52	24	18	0	
85	4	51	17	17	0	
84	1	50	28	16	0	
83	3	49	18	15	0	
82	2	48	14	14	1	
81	4	47	12	13	0	
80	4	46	8	12	0	
79	6	45	23	11	0	
78	2	44	12	10	0	
77	3	43	10	9	1	
76	3	42	6	8	0	
75	2	41	3	7	0	
74	4	40	9	6	0	
73	6	39	4	5	0	
72	7	38	2	4	0	
71	12	37	1	3	0	
70	14	36	0	2	0	
69	10	35	3	1	0	
68	5	34	7	0	0	
67	8	33	4			

Table 22. Distribution of raw scores for ninth grade Kansas girls on the language usage - spelling section of the DAT.

Raw Score	Number	Raw Score	Number	Raw Score	Number	N=648
100	0	66	4	32	4	
99	0	65	5	31	6	
98	5	64	10	30	9	
97	0	63	0	29	6	
96	1	62	8	28	7	
95	0	61	5	27	8	
94	2	60	15	26	13	
93	0	59	1	25	4	
92	1	58	13	24	7	
91	0	57	2	23	7	
90	5	56	10	22	8	
89	1	55	4	21	3	
88	7	54	10	20	7	
87	1	53	2	19	1	
86	6	52	14	18	10	
85	0	51	1	17	9	
84	5	50	18	16	6	
83	3	49	10	15	4	
82	8	48	9	14	6	
81	0	47	2	13	3	
80	7	46	10	12	9	
79	2	45	3	11	2	
78	7	44	11	10	8	
77	1	43	45	9	1	
76	5	42	9	8	4	
75	2	41	5	7	2	
74	8	40	11	6	12	
73	0	39	3	5	3	
72	9	38	13	4	6	
71	3	37	6	3	3	
70	12	36	8	2	5	
69	3	35	7	1	4	
68	9	34	9	0	59	
67	2	33	4			

Table 23. Distribution of raw scores for ninth grade Kansas girls on the language usage - sentences section of the DAT.

Raw Score	Number	Raw Score	Number	Raw Score	Number	N=641
95	0	62	1	29	16	
94	0	61	4	28	11	
93	0	60	4	27	18	
92	0	59	2	26	16	
91	0	58	8	25	19	
90	0	57	0	24	10	
89	0	56	4	23	13	
88	0	55	8	22	16	
87	0	54	8	21	22	
86	0	53	8	20	13	
85	0	52	3	19	9	
84	0	51	5	18	14	
83	0	50	8	17	11	
82	0	49	7	16	9	
81	0	48	2	15	14	
80	0	47	7	14	12	
79	0	46	14	13	7	
78	0	45	9	12	5	
77	1	44	13	11	12	
76	0	43	4	10	3	
75	0	42	11	9	9	
74	0	41	14	8	12	
73	0	40	11	7	7	
72	0	39	10	6	12	
71	1	38	11	5	5	
70	0	37	8	4	7	
69	0	36	8	3	4	
68	1	35	13	2	2	
67	1	34	12	1	7	
66	1	33	9	0	39	
65	1	32	20			
64	2	31	17			
63	1	30	15			

THE DIFFERENTIAL APTITUDE TEST: BACKGROUND, THEORY AND PROPOSED NINTH GRADE NORMS FOR KANSAS

by

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Since the 1920's there has been increasing recognition of limitations of the single score "IQ test" and more interest in the type of test, based on factor analysis, that separated intelligence into factors or specific aptitudes.

In the last 10 to 15 years many batteries have been published which were factored into sub-tests by this technique. An individual approaching the testing situation may become confused by the variety of tests available and the sometimes contradictory evidence available concerning these tests. This report concerns itself with a review of the literature about factor analysis, a review of some of the current tests, particularly the Differential Aptitude Test, proposed ninth grade norms for the DAT, and a comparison of these norms with national norms supplied by the Psychological Corporation.

A series of articles published in the American Personnel and Guidance Journal concerning the multi-factor test batteries was reviewed with appropriate outside references. Three Kansas high schools having professional counselors using the DAT supplied raw scores for this study. These raw scores were compiled into norms for the state of Kansas for the ninth grade. Few scores were available in grades other than the ninth.

No significant differences of practical importance were found between national norms for the ninth grade and the proposed Kansas norms for the ninth grade.

It appears desirable that as soon as the DAT is used in a more representative sampling of Kansas high schools a similar study be made on a more representative population. Also, a particular high school using the DAT should build up local norms and make comparisons of these with the national norms to determine significant differences. Such differences should be then taken into account in making comparisons within the school.

Further, it is recommended that high school counselors, teachers, and principals make more extensive use of differential aptitude testing. In general, most high schools in Kansas are not yet making use of the most significant research and developments of the past 10 to 15 years in guidance testing.